appropriations will be made for this purpose, especially for the printing of papers of acknowledged importance, so abstruse, so extended or so costly that without the aid of this fund they may not see the light.

With respect to certain large undertakings involving much expense, which have been or may be suggested, careful preliminary inquiries have been and will be made.

In order to secure the counsel of experts in various departments of knowledge, special advisers have been and will be invited from time to time for consultation. Valuable suggestions and counsel have already been received from such advisers.

DANIEL C. GILMAN,
President of the Carnegie Institution.

WASHINGTON,
November 25, 1902.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION B, PHYSICS.

THE sessions of Section B, in affiliation with the American Physical Society, at Washington, were very successful; the attendance was much larger than has been usual, and it was characterized by the presence of many leading physicists representing a wide territory. Forty-five papers of a high average quality were given; twenty-six of these were presented before Section B, and nineteen before the Physical Society. The number of papers would undoubtedly have been much larger had not this meeting followed so closely upon the Pittsburgh meeting. Nearly every paper drew forth some discussion, though it would seem that this feature of the sessions might be extended with profit. A rough classification of subjects shows that fourteen were on optics, twelve on electricity and magnetism, eight on general subjects, six on heat, three on sound and two on meteorology.

Ernest F. Nichols, vice-president of Section B, and Arthur G. Webster, vice-president of the American Physical Society, were the presiding officers.

In accordance with the revised constitution, several officers were elected to serve at the Washington meeting and also at future meetings, the object being to secure a more consistent and efficient policy of administration. Those officers which serve for several meetings, including the Washington meeting, are Dayton C. Miller, secretary for five years; and the following members of the sectional committee, Gordon F. Hull, five years; Arthur G. Webster, four years; D. B. Brace, three years; Ernest Merritt, two years; Ernest F. Nichols, *ex officio,* two years. The other officers for the Washington meeting, in addition to those mentioned above, were Henry S. Carhart, member of the council; W. S. Franklin, *ex officio* member of the sectional committee; Charles E. Mendenhall, member of the sectional committee; George F. Stradling, member of the general committee, and Lyman J. Briggs, press secretary.

The vice-president for the next, the St. Louis, meeting is Edwin H. Hall, of Harvard University.

On Monday the retiring vice-president, W. S. Franklin, gave an address on 'Popular Science,' which was listened to with great interest, and which drew out some spirited and valuable discussion. The paper has been given in full in a previous issue of SCIENCE. The abstracts of the other papers presented before Section B are given below:

The Semidiurnal Periods in the Earth's Atmosphere: FRANK H. BIGELOW, U. S. Weather Bureau.

There occur at the surface of the earth two types of diurnal periods in the meteorological elements. The temperature,

the wind direction and velocity, and the solar radiation have each one maximum and one minimum; the barometric pressure, the vapor tension, the electric potential have two maxima and two minima. There has been great difficulty in accounting for the simultaneous occurrence of these two types. Lord Kelvin advocates the theory of a forced semidiurnal dynamic wave in the atmosphere, and Dr. J. Hann, after vainly trying to reconcile the temperature and the pressure curves, appears obliged to accept Kelvin's view. Recent observations in the lower strata of the atmosphere with kites and balloons show that the surface double-wave becomes a single-wave at altitudes which are very moderate, about that of the cumulus clouds. It becomes, then, necessary to account for the transformation of the double- into the single-wave within these strata. It is done in this paper by discussing the action of the solar radiation in the atmosphere, and upon the earth's surface; and especially by indicating the effect of the outgoing terrestrial radiation upon the aqueous vapor sheet. This rises and falls daily, and it is shown by the method of volume contents of dry air and aqueous vapor that the known facts harmonize closely with the new theory as set forth by the author. Incidentally, a discussion of the normal solar spectrum energy curves at different temperatures, and the observed depleted energy curve as given by Professor Langley, indicates that the solar constant is probably about 4.0 gram calories and that the temperature of the solar photosphere is not far from 7500° C.

The Construction of a Sensitive Galvanometer. C. G. ABBOTT, Smithsonian Institution. With an introduction by S. P. LANGLEY, Smithsonian Institution.

For the last seven years the galvanometer of the bolometric apparatus of the Smithsonian Astrophysical Observatory has been frequently modified in the interest of greater working sensitiveness. Starting in 1896 with a four-coil instrument of about 25 ohms resistance and with a computed constant of 2×10^{-10} ampères for a ten-seconds single swing, with scale distance one meter, it has now become a sixteen-coil instrument of only 1.6 ohms resistance and with an actual working constant at ten-seconds single swing of 5×10^{-11} ampères for scale distance of one meter. In practice, however, the scale distance is four meters, and one tenth division is readable, so that a current of about 1×10^{-12} ampères can be measured. The paper of Mr. Abbott describes the successive steps by means of which this change has occurred. These include modifications of the construction of support, case, surroundings, coils, needle system and mode of reading.

The Condition Governing the Coherence of Metals when there is an Electrical Discharge between them: CARL KINSLEY, University of Chicago.

In the many studies of coherence that have been made there has usually been a complete disregard of several of the conditions controlling coherence. It is necessary to know not only the potential at which the discharge takes place, but also the quantity of the discharge. The dielectric between the metals and its condition as to temperature and pressure is also of great importance. The condition of the surfaces, their size, shape and distance apart, must be known.

An apparatus enabling distance of the order of one four-hundredth of a wave-length of light to be measured was used. This made it possible to carry on the experimental work within distances such as those found in the usual form of coherer.

A Determination of the Frequency of Alternating Currents by the Automatic Adjustment of the Circuit to Resonance: Carl Kinsley, University of Chicago.

An electric current can be tuned to any frequency within a wide range by varying the self induction of the circuit. This may be automatically accomplished by using a moving core in the coil giving self induction. If the spring-held core is slightly beyond the position of resonance in the direction of too large self induction, it will be retained in equilibrium between the force of the spring and the pull of the coil. The plunger will, therefore, rise and fall in the coil as the varying frequency requires a greater or less self induction for resonance.

Charts were used showing the mode of operation of the method proposed.

On Methods of Measuring Radiant Efficiency: E. L. Nichols and W. W. Coblentz, Cornell University.

This paper deals with the visible and infra-red spectrum of the light transmitted by a water cell and by a water cell and iodine cell in combination, for the purpose of determining the nature of the correction which it is necessary to apply in finding the true radiant efficiency of sources of light. It is shown that in the case of a water cell one centimeter in thickness, at least five sixths of the transmitted energy belongs in the infra-red transparency of an iodine solution which is opaque to the visible rays is not such as to warrant the use of this cell for the purpose of determining the correction for the water cell. Comparison was made between the value for the radiant efficiency by the usual method of the water cell, the same value corrected by integration of the curves for the transmitted energy of the cell and the value of the radiant efficiency obtained by direct integration of the energy curve of the spectrum of the source. The recent contention of Angström that all determinations of radiant efficiency by means of the water cell thus far published give much too large a value, is shown to be fully justified.

The Infra-red Emission Spectrum of the Mercury Arc: W. C. Geer and W. W. Coblentz, Cornell University. Presented by E. L. Nichols.

While investigating the infra-red spectrum of the Aron's lamp, a grouping of the emission lines was observed which is of interest in connection with spectral series.

The vertex of the arc was used for a source of radiation. For this purpose a side tube, having a window of fluorite or rock salt, was placed at right angles to the plane of the arc. The spectrum was produced by means of a mirror spectrometer and rock-salt prism, while a Nicholas radiometer was used to measure the distribution of energy.

The spectrum was explored at every minute, and at certain places every 20″ of arc of the spectrum circle up to 9 μ. It was found that the energy radiated consists of a series of emission bands at 1 μ and 5 μ, with a slight indication of a band at 3 μ. Nowhere in the spectrum was the intensity of the radiation from the arc very great, while beyond 6 μ the deflections due to the hot glass walls of the lamp were as great as those due to the arc. The lamp was kept in a water-bath.

The width of the spectrum covered by the radiometer vane at 1 μ was about .13 μ. The error at 1 μ is less than .01 μ, while at 4 μ the error is perhaps .03 μ.

Since in the region at 3 μ the radiometer showed slight deflections at times which were recorded as questionable, and since in all other parts of the spectrum from 2 to 4 μ no such effect could be detected, one is

led to believe that the indications at 3 μ were real. The great variation in the intensity of these lines may be due, in part, to the fact that the slit subtends different angles in the two regions, and that the suspected line at 3 μ is isolated, while the others occur in a group in which the intensity of each one is influenced by those adjoining it.

The presence of the bands of larger wave-lengths than 4 μ indicates that the true radiant efficiency of the arc is lower than the values found in a previous investigation.

Experiments concerning Very Brief Electrical Contacts: HERSCHEL C. PARKER, Columbia University.

A series of electrical contacts giving a fairly accurate range of adjustment from 0.1 second to 0.00001 second would furnish a valuable means of investigation. A gravity contact key devised by Dr. Charles Forbes gives promise of fulfilling the above conditions. The writer has made many determinations of the times of contact given by the various devices employed on this key, and has also investigated the times of contact of several forms of pendulum.

The method employed was as follows: a condenser of known capacity (F, farads) was charged during the time of contact (T) and the deflection on discharging noted. This deflection (if a good mica condenser is used which has no absorption) is proportional to the electromotive force (E) and the capacity (F). The condenser is again charged through a resistance (R) and the deflection (Q) observed. Then:

$$Q = EF \times (1 - e - T/RF)$$

and,

$$T = -RF \times \log e\,(1 - Q/EF).$$

The 'gravity key' consists essentially of a rectangular weight falling on metal guides, the key being furnished with a scale divided in fractions of a second, according to the law of falling bodies, and the weight actuating the various forms of switches employed. If two switches are used, one to make the contact and the other to break the contact, by placing them at different distances apart on the scale, times of contact varying from 0.4 second to 0.001 second may be obtained. For shorter times a single switch that makes and breaks the contact is made use of, and the time made faster or slower by placing in different positions on the scale so that the falling weight strikes it with varying velocities.

In one form, the weight moves the short arm of a lever, the long arm passing over a contact strip. Another form is one in which the fulcrum of the lever changes, first giving contact and then breaking the circuit immediately afterwards. In still another type the falling weight strikes a lever arm and releases a spring, which makes the contact, and a further motion of the lever breaks the contact, thus giving a differential effect between the velocity of the weight and the rapidity of the spring. With this key it is possible to obtain a contact of only 0.000017 second and with careful adjustment it seems possible to reach 0.00001 second.

Experiments made with pendulums consisting of a steel ball suspended by a wire, and striking against a steel anvil, gave very positive and satisfactory contacts. Using a pendulum with the suspension wire about four meters long and the steel ball two inches in diameter, an arc of $\frac{1}{2}°$ gave 0.00039 second, while a pendulum with a short suspension wire using one-half-inch steel ball, through an arc of 90° gave 0.000079 second.

It is interesting to note that in working with condensers the best mica condenser gives no appreciable variation in capacity

for the very briefest times of charge, while a paraffine condenser may show a reduction in capacity of some sixty per cent. from a time of charge of 0.4 second to that of 0.001 second.

Derivation of Equation of Decaying Sound in a Room, and Definition of Open Window Equivalent of Absorbing Power of the Room: W. S. Franklin, Lehigh University.

1. The paper presents a derivation of the equation

$$i = Ie^{-\frac{86a}{v}\cdot t},$$

in which I is the initial intensity of sound in a room, i is the intensity t seconds after the source has ceased, v is the volume of the room, a is the open window area which is equivalent to the absorbing power of the wall and objects in the room, and e is the Naperian base.

2. The paper then gives a definition of the open window equivalent of the absorbing power of the walls and objects in a room.

3. The paper then compares the theoretically derived equation for duration of reverberation, namely,

$$t_1 = 0.165\frac{v}{a},$$

with the equation used by Sabine in which the numerical factor is based upon experiment.

4. The paper then discusses briefly the physical actions involved in the absorption of sound by the walls and objects in a room.

On the Velocity of Light as affected by Motion through the Ether: Edward W. Morley, Western Reserve University, and Dayton C. Miller, Case School of Applied Science.

The theory of the Michelson-Morley experiment contained in their paper of 1887 was elaborated as far as seemed needful in view of the negative result of their experiment. This paper gives some account of a more detailed theory and announces some preliminary results of the more recent experiments.

Some Measures of the Speed of Photographic Shutters: Edward W. Morley, Western Reserve University, and Dayton C. Miller, Case School of Applied Science.

A stroboscopic electrically driven tuning-fork and a special camera containing a cylindrical sensitive film were arranged to obtain graphic representations of the behavior of shutters. The exact manner and time of opening and closing, as well as the aperture and duration of exposure, are recorded.

Of the better grade of shutters designed to give definite and adjustable exposures, it was found that they were fairly constant in operation, but that the actual duration of exposure is often not even approximately that indicated by the maker. Different shutters of the same make and form give widely different exposures when set for the same time. It was found in all the shutters tested that the times marked one seventy-fifth of a second or less were all of the same duration, and that this was much less than the shortest marked time, namely, from three to four thousandths of a second. If the time scale for each separate shutter of this grade were constructed upon tests of the shutter, it might then be used to give practically correct exposures.

With the best shutters of the diaphragm class the duration of exposure is nearly independent of the aperture of the opening.

Some shutters of the cheaper grades designed to give long, medium and short exposures were found to give equal ex-

posures in the three cases. In general, shutters of this grade with timing devices are wholly unreliable.

On the Distribution of Pressure around Spheres in a Viscous Fluid: S. R. COOK, Case School of Applied Science.

When a single sphere is set in motion in a perfect fluid at rest at infinity, its motion is completely determined by the velocity potential due to the motion of the sphere; and the pressure around the sphere is given by

$$\frac{p}{\rho} = \frac{d\varphi}{d\tau} - \tfrac{1}{2}u^2 + F(t) \qquad (1)$$

Where φ is the velocity potential and u is the velocity of the sphere at time t.

When u is constant (1) may be written in the form

$$\frac{p}{\rho} = u^2 \{\tfrac{9}{8}\cos^2\theta - \tfrac{5}{8}\}, \qquad (2)$$

where θ is measured from the direction of motion.

The curve for the pressure of a perfect fluid around a sphere was given, and also the curve for the pressure of air, which was determined by measuring the pressure of the air around a glass sphere by means of a water manometer while the air is flowing with a constant velocity past the sphere. The two curves differ, in that, for a perfect fluid the curve is symmetrical with respect to both axes, as may be seen from (2), while for a viscous fluid, *i. e.*, air, the curve is symmetrical with respect to the axis parallel to the direction of flow, but not with respect to the axis at right angles, the pressure at the rear being less than that in front of the sphere.

The pressure was also determined for two spheres moving in line of centers and for two spheres moving perpendicular to the line of centers. The equations which represent the pressure for a perfect fluid were given and the curves of pressure around the spheres compared with the curves obtained by measurements of the pressure in air. It was found that two spheres moving in the line of their centers in a perfect fluid are repelled, but when moving in a viscous fluid are attracted. For spheres moving perpendicular to their line of centers in a perfect fluid they were attracted, and in a viscous fluid repelled.

These results agree with results given in a former paper on 'Flutings in a Sound Wave' and corroborate the theory there advanced as an explanation of the cause of the flutings in a Kundt-tube.

A Portable Apparatus for the Measurement of Sound: A. G. WEBSTER, Clark University.

An improved form of the instrument shown at the Boston meeting, 1898.

The apparatus consists of two parts, a 'phone,' or apparatus for emitting continuously a pure tone, whose intensity is measured in absolute units (watts), and of a 'phonometer,' or instrument which measures at any point the intensity of the sound emitted by the phone or other source of sound measuring the absolute compression of the air. The amplitude of a diaphragm forming the back of a resonator is measured by the displacement of fringes in an interferometer, observed stroboscopically. Both parts of the apparatus are portable, and suitable for field work.

The Mechanical Efficiency of Musical Instruments as Sound Producers: A. G. WEBSTER, Clark University.

The sound emitted was measured by the phonometer, by comparison with the phone placed in the same place where the instrument was. The input of energy was obtained by measurement of the pressure, and time rate of air consumption for wind instruments, and by the pull of the bow and velocity for stringed instruments. Preliminary results were given for the

cornet, French horn, bombardino, saxophone, clarinet, oboe, voice and violin. The mechanical efficiency is generally between one thousandth and one hundredth. An idea of the magnitudes involved can be got from the statement that the sound emitted from five to ten million cornets would equal a horse-power.

The Damped Ballistic Galvanometer: O. M. STEWART, University of Missouri.

It is usually assumed that a ballistic galvanometer if well damped does not give deflections strictly proportional to the quantity of electricity discharged through it. It has, however, been found experimentally that such an error if any is very small. The theory of the ballistic galvanometer is developed for the two general cases: (1) periodic vibrations, and (2) aperiodic vibrations. In both cases the deflection is strictly proportional to the quantity discharged through it. Effect of the damping on the sensibility of the galvanometer is discussed.

On the Electrical Conductivity of Solutions in Amyl Amine: LOUIS KAHLENBERG, University of Wisconsin.

The dielectric constant of amyl amine is 4.50, while that of chloroform is 3.95 and that of ether is 4.37. Chloroform solutions that conduct electricity appreciably are unknown; ethereal solutions are also extremely poor electrolytes. Ferric chloride dissolved in chloroform or ether yields solutions that are practically insulators. It was, therefore, of interest to determine the conductivity of solutions in amyl amine. The amyl amine was dried with fused caustic potash and redistilled. Its specific conductivity was less than 8.2×10^{-8}. Cadmium iodide, silver nitrate and ferric chloride are soluble in amyl amine, and the solutions are electrolytes. Their conductivity was measured by means of the Kohlrausch method. In the case of cadmium solution the molecular conductivity first increases with the dilution and then it increases on further dilution, the maximum (0.542) occurring when one gram molecule is contained in about one and one tenth liters. The mol. cond. is almost *nil* when one gram mol. is present in six liters. Silver nitrate solutions act similarly, the maximum (1.48) occurring when one gram mol. is present in about one and two tenths liters. The cond. is exceedingly low when one gram mol. is contained in 31 liters. In the case of ferric chloride the mol. cond. decreased continuously (from 0.217 at $v = 5.021$) as the solution became more dilute, rapidly dwindling to a very small value at about the same concentration as the $AgNO_3$ solutions. The conductivities of solutions of these three salts at higher dilutions than those mentioned were found to be practically negligible. The results show that, contrary to what one would expect according to the Nernst-Thomson rule, amyl amine yields solutions that conduct well enough readily to admit of measurement. Again the change of the mol. cond. as the solutions are diluted is such that it can not be harmonized with the theory of electrolytic dissociation. The fact that the mol. cond. dwindles to practically nothing in solutions of the concentration above mentioned is particularly interesting. Potassium iodide and sodium oleate are insoluble in amyl amine. Copper oleate is soluble, but the solutions conduct no better than the pure solvent.

On the Thermal Conductivity of Glass: H. W. SPRINGSTEEN, Case School of Applied Science.

Some Relations between Science and the Patent System: CHARLES K. WEAD, U. S. Patent Office.

This informal paper will call to the at-

tention of the section as it meets in Washington certain unique opportunities for research afforded to the public by the Patent Office and printed patents.

The relations may be grouped under three heads:

1. The patent system, its laws, methods and collections, as an organized body of material.

2. Scientific men as inventors and patentees.

3. The usefulness of printed patents to scientific men.

Why the E.M.F. of the Daniell Cell changes when the Densities of the Solutions Change: HENRY S. CARHART, University of Michigan.

In my paper read at the Pittsburgh meeting of the American Association for the Advancement of Science I applied the increase of thermo-electromotive force per degree between a metal and a solution of one of its salts with the density of the solution to the above problem. An increase in the density of the zinc sulphate solution increases the back thermo-electromotive force, and so decreases the E.M.F. of the cell as a whole.

The writer's explanation has been criticised on the ground that the heat of formation of both zinc sulphate and copper sulphate, in aqueous solution, decreases as the density increases. The result would appear to be a rational explanation of the change of E.M.F. of the Daniell cell without any regard to the thermo-electromotive force and its variation with the density of the solution.

To test this question I have measured the E.M.F. of a Daniell cell of a special form set up with concentrated copper sulphate solution, and, first, with $1/16N$ zinc sulphate solution; and, second, with a normal zinc sulphate solution. The E.M.F. in the second case is less than in the former by 0.021 volt at 20° C. The difference calculated from the thermo-electromotive forces is 0.029 volt, without taking into account the E.M.F. at the junction of the two solutions. The thermal E.M.F. is then abundantly large enough to explain the phenomenon.

Further, the most interesting fact about this is that the observed change of E.M.F. of the Daniell cell is exactly the E.M.F. of a concentration cell set up with the two zinc sulphate solutions. A little consideration shows that such should be the case, but I am not aware that this point has been observed before.

Preliminary Report on an Absolute Measurement of the E.M.F. of the Cadmium Cell: HENRY S. CARHART and KARL E. GUTHE, University of Michigan.

The paper will describe the preparation of the materials for the cadmium cells used, will give a comparison of their E.M.F.'s, will describe the new electrodynamometer built for the measurement of the current which produces a fall of potential over a known resistance, this fall of potential being compared with the E.M.F. of the cadmium cell. If secured in time, some results of the measurement will also be given.

The Characteristic Absorption Curves of the Permanganates: B. E. MOORE, University of Nebraska.

A spectrophotometric study of solutions of potassium and zinc permanganate was made. These solutions were prepared nearly saturated (concentration not yet determined). Then solutions diluted 10, 100 and 1,000 times were studied.

For all points in the spectrum the value K (the thickness of the standard concentration which would absorb ninety per cent. of light) is calculated. This value changes from point to point in the spectrum, but should not change at any fixed point in

the spectrum upon dilution, unless some change in the solution occurs. The strongly absorbing region of these solutions shows five bands. Ostwald shows that twelve permanganates in dilute solution show identical positions for four of these bands, which suggests at once identical color for common ions. Indeed, Ostwald gives a large series of solutions of different common ions to support this conclusion. Still, it must be readily recognized that the color of a solution is determined by the magnitude of absorption, both inside and outside the absorption band, as well as by the position of the bands. This determination requires a spectrophotometric study, although it is a tediously slow process in comparison to the other method. Spectrophotometrically studied those two permanganates show that the bands are identical for both substances in all concentrations. For the potassium permanganate the relative transparency in the band region increases slightly upon dilution. The zinc permanganate remains constant for all concentrations in this region. Outside the characteristic absorption bands, in both blue and red, both solutions show marked increase in relative absorption upon dilution. That is, increased ionization has caused a change *outside* the bands, not *in* the band region itself.

Note: Even in concentrated solutions, permanganates would have a large dissociation coefficient, hence a small difference in ionization could only be realized upon great dilution. Owing to the slight solubility of several permanganates, one is still farther restricted in the choice of substances. Hence so far I have only been able to examine the two substances.

The Magnetic Rotary Dispersion of Solutions of Anomalous Dispersive Substances: F. J. Bates, University of Nebraska. Presented by D. B. Brace.

The rotation of the plane of polarization of a ray of light, when passed through a substance in a direction parallel to the lines of force, has been found on theoretical grounds to be proportional to $du/d\lambda$, where u is the index of refraction of the substance for the wave-length λ. Consequently in solutions showing anomalous dispersion there should be an anomaly in this rotation wherever there is an anomaly in the refractive index. The author has studied very dilute solutions of fuchsin, cyanin, analine (blue) and litmus with an improved form of polariscope. The mean error of a setting for any wave-length was less than .01°; while the best results claimed by previous investigators, who obtained anomalous effects, is a probable error of .03°.

The first observations indicated that the apparent anomalies were present in these solutions; but further investigation proved them to be spurious. After eliminating these effects no anomalies were obtained. Hence, although anomalous dispersive substances may possess an anomalous Faraday effect, its magnitude is much less than it has heretofore been considered.

The Investigation of the Atmospheric Circulation in the Tropics: A. Lawrence Rotch, Blue Hill Meteorological Observatory.

It is generally believed that the currents which ascend from the thermal equator proceed immediately as southwest and northwest anti-trades over the northeast and southeast trades-winds, and that the greater part of the anti-trade descends to the surface of the ocean north and south of the trades and continues to the poles as the prevailing southwest or northwest winds of the north or south temperate zones. This hypothesis is not sustained by the observations of the movements of volcanic dust and of upper clouds, which indi-

cate a strong easterly wind above the equator, shifting suddenly, at about 20° north and south latitudes, to southwest and west. We do not know the depth of the trades, and nothing about the vertical variations of temperature and humidity over the ocean, nor whether sudden changes in these elements occur between the trade and the anti-trade.

The author proposes to investigate these and other questions by means of kites carrying self-recording instruments which, flown from his observatory on Blue Hill, near Boston, during the past nine years, have much increased our knowledge of the atmosphere in this region up to a height of three miles. Experiments made by him in 1901, in flying kites from a steamer crossing the north Atlantic, proved that in this way observations could be obtained in the upper air independently of the wind.

He now desires to make these atmospheric soundings between the Azores and Ascension Island, and is endeavoring to obtain the funds necessary to charter and equip a steamer, believing that in this way some of the most important problems in meteorology and physical geography may be solved.

Anomalous Dispersion and Selective Absorption of Fuchsin: WM. B. CARLMEL, National Bureau of Standards. Presented by D. B. Brace.

To give a brief and concise account of this work, I may state that it consists of a determination of the dispersion curve by interferential means, and of the absorption by means of a Brace spectrophotometer. The methods of procedure have necessarily been somewhat novel because fuchsin is so strongly absorbing that it is not possible to determine the dispersion curve in the usual manner.

The chief difficulty in the determination of the dispersion curve by interferential means is that the light of one path of the interferometer, after passing through the film, is so reduced in intensity that it is too weak to produce interference when it meets the undiminished light from the other path. By partly balancing up the intensity of the two paths by means of an absorbing screen, and by using a form of interferometer which only allowed the light to traverse the film once, and which rejected the enormous amount of light reflected from the surface of the film, it was found possible to obtain good fringes throughout the visible spectrum. The retardations were determined by means of spectral bands, using a mica compensator.

The absorption of the same specimen of fuchsin was determined by means of a form of spectrophotometer which allowed an unusually great intensity of light to be used. The absorption has only been determined in part before, because of the difficulties encountered. A complete determination has been made throughout the spectrum, which agrees quite well with the values found by other experimenters in the portion of the spectrum in which they had made measurements.

The work was done upon films of from 0.2 micron thick to 0.6 micron thick. The thicknesses were determined from the interference bands of thin films, and are correct to within about four or five per cent.

The Coefficient of Expansion of Some Alloys of Nickel and Cast Iron: THEO. M. FOCKE, Case School of Applied Science.

In Appendix No. 6 of the report of the Coast and Geodetic Survey for 1900, Mr. E. G. Fischer describes a new precise level, in which an alloy of nickel and cast iron replaces the brass ordinarily used.

The experiments described in this paper were undertaken to find the composition

of the alloy which should have the least coefficient of expansion. The results are given in the following table:

Percentage.		Coefficient.	Mean Temp.
Nickel.	Cast Iron.		
33⅓	66⅔	.00000543	31.5
35	65	.00000410	31.5
36	64	.00000397	31.0
36½	63½	.00000403	32.0

Sulphur Dioxide and the Binary-Vapor Engine: R. H. Thurston, Cornell University.

A New Apparatus for Demonstrating Wave Motion: Fred. J. Hillig, St. John's College.

The instrument is used to demonstrate the theory of radiation, particularly the different wave-forms (longitudinal and transversal), polarization and diffraction. The apparatus consists of a network of rubber strings, at the intersection of which lead balls are suspended.

Demonstration of a Portable High Tension Coil and Ozone Generator: G. Lenox Curtis, New York city.

For several years I have been experimenting with a high tension coil which is attached to the street main of 110 or more volts. The current is multiplied to one million volts, while the ampèrage is reduced to a fraction of one ampère. The object of the apparatus is to produce ozone for therapeutical purposes. It apparently has but a single pole, the atmosphere being the negative pole.

To the coil are attached ozone generators, inhalers, Geisler and X-ray tubes. The apparatus is portable and can be used wherever there is an incandescent current, or the current may be supplied from a battery; it is, therefore, adapted to sickroom practice. The current and ozone, by this device, may be carried into and through the body, oxidizing pathogenic conditions, reestablishing nutrition, and restoring the blood to normal. There is no shock nor unpleasant feeling to the patient. This method as demonstrated by five years' active practice, in which many diseases have been treated, is probably the most effective of any now in vogue. It appears to be equally advantageous in the treatment of acute and chronic cases. It quickly reduces fevers, controls pneumonia and diseases of suppurative character, and increases vitality. By passing the electrode over the body, superficial and deep-seated congestions may be located, and within an unusually short period normal circulation is reestablished. This fact has been demonstrated in the treatment of meningitis, pneumonia, tuberculosis, neuritis, etc., and the long chain of affections arising from autointoxication is virtually controlled. Sufficient ozone can be generated by this device to quickly disinfect the sickroom or hospital ward.

Dayton C. Miller,
Secretary of Section B.

MEETING OF THE AMERICAN PHYSICAL SOCIETY.

On Wednesday, December 31, a joint meeting of Section B and the American Physical Society was held, at which Professor A. G. Webster, vice-president of the society, presided. The annual election resulted in the choice of the following officers for the current year:

President—Arthur G. Webster.
Vice-President—Elihu Thomson.
Secretary—Ernest Merritt.
Treasurer—William Hallock.
Members of the Council—W. F. Magie and E. H. Hall.

The first paper on the program was by Dr. L. A. Bauer, 'On the Results of Comparisons of Magnetic Instruments.' These comparisons had been made by the magnetic survey and showed a very satisfactory agreement among the different instru-